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Risk Propensity and Health Risk Behaviors in U.S. Army Soldiers with and without Psychological Disturbances across the Deployment Cycle

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14. ABSTRACT

Three potential factors driving changes in health risk behaviors after a combat deployment were examined in this study; posttraumatic stress disorder (PTSD), concussion and traumatic brain injury (TBI), and perceived invincibility. We studied members of a combat arms brigade one month prior to a deployment to Iraq and approximately one month after their return (N = 319). Participants anonymously completed surveys characterizing attitudes about risk, risk propensity, invincibility, engagement in health risk behaviors, and personality. Using standardized screening instruments, participants were categorized with respect to PTSD and probable TBI. Results suggest that Soldiers engage in more alcohol use and reckless driving behaviors post-deployment. These changes were exaggerated in those who screened positive for PTSD. Perception of one's invincibility and survival skills increased post-deployment thus suggesting that participants felt less susceptible to adverse consequences and more adept at surviving dangerous situations. This study provides documentation of the health behavior pattern in Soldiers engaged in the deployment cycle.

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risk propensity, combat deployment, health risk behaviors

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Background

Over one million service members have deployed to support Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF). The conditions under which these Soldiers carry out their missions are both physically and psychologically stressful. Soldiers returning from an overseas deployment such as OIF or OEF are vulnerable to the effects of combat stress. The strain of combat does not selectively discriminate, and the mental and physical exhaustion that follows takes its toll on both the inexperienced and seasoned veteran alike. Despite sound military training and advanced technology, personal resilience is not equal for every Soldier who endures combat. Soldiers, being human, instinctively safeguard the basic need for self-preservation when threatened, and each experience is uniquely processed by the individual over the course of deployment.

Combat experience is associated with mental health problems (Hoge et al., 2004; Killgore et al., 2008; Sharkansky et al., 2000). In 2008, RAND Corporation published a report estimating that 14% of Soldiers returning from OIF and OEF experience posttraumatic stress disorder (PTSD), 14% experience major depression, and 19.5% have sustained a mild traumatic brain injury (mTBI; Tanielian & Jaycox, 2008). Of those who have suffered an mTBI during deployment, 35% experience persistent symptoms or postconcussive syndrome (PCS; Schneiderman, Braver, & Kang, 2008). The full extent of the psychological effects of ongoing military operations is unknown.

One aspect of the psychosocial effect of combat is the reported increase in risky behaviors exhibited by Soldiers post-deployment. Killgore et al. (2008) found that Soldiers who experienced more severe and intense combat were at a slightly greater risk of engaging in high risk behaviors post-deployment. While this finding was statistically significant, the effect size was small, indicating that combat exposure only accounts for a small proportion of the variance with respect to risky behavior. It is unclear what other factors may influence risk propensity following combat exposure. Likewise, in a recent study, Thomsen, Stander, McWhorter, Rabenhorst, and Milner (2011) found that when surveyed, service members who had deployed reported engaging in more risky behaviors than those who had never deployed.

Potential predictors/correlates of risk propensity and risky behaviors

Combat exposure

The effects of prolonged exposure to emotional stressors (e.g., combat-related) may impact regions of the brain (specifically the limbic system) in such a way that Soldiers may have difficulty adjusting to a non-wartime environment upon returning from a deployment (Killgore et al., 2008). Soldiers with PTSD have diminished activity in the limbic system and regions of the prefrontal cortex, which might suggest low basal arousal levels (Molina, Isoardi, Prado, & Beltolila, 2007). Additionally, young adults with a history of head injury exhibit a greater interest in risky behaviors (O'Jile, Ryan, Parks-Levy, Betz, & Gouvier 2004). One potential mechanism driving similar behavior post-deployment is the impact of psychological combat trauma--particularly perceived "near-death" experiences--on one's beliefs and behaviors related

to life and death. These changes in beliefs and behaviors are not a manifestation of any mental illness but may function as a coping mechanism (Bell, Amoroso, Wegman, & Senier, 2001). Whereas the Thomsen et al. (2011) recent cross-sectional study reported changes in behavior from pre- to post-deployment, a longitudinal study will provide stronger evidence to our understanding of the relationships between deployment and adverse health outcomes.

Sensation seeking

Zuckerman (1994) defines sensation seeking as "a trait defined by the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of the experience" (p 27). Given this definition, a sensation seeker tends to underestimate risks and accept risks as the necessary cost for the desired sensation or stimulation gained from an activity or behavior. In other words, high sensation seekers compared to low sensation seekers judge an activity's risk level to be lower so as to justify engaging in the activity for the stimulation and sensation desired. The risks associated with an activity are not the driving force behind sensation seekers' behavior but rather the stimulation gained from the experience. Low sensation seekers not only tend to be risk averse but do not gain the same experience from the activity as high sensation seekers. In order to illustrate the link between sensation seeking and risky behavior, it is necessary to explore the role of state anxiety. Zuckerman argued that one's state anxiety is dependent on the perceived risk level and when anxiety states are stronger than sensation seeking states, then one pulls away from the risky behavior. High sensation seekers' anxiety state does not overpower the motivation for the sensation thus leading them to engage in the behavior whereas low sensation seekers' anxiety state does overpower thus leading to rejection of the behavior. Zuckerman's Sensation Seeking Scale (SSS-V) is composed of four factors; boredom susceptibility, experience seeking, thrill and adventure seeking, and disinhibition and is a well validated, highly reliable measure to identify high and low sensation seekers in a test population.

Self-regulation

Recent research has suggested that self-regulatory competence, defined as the ability to control and adjust one's own emotions and desires, is linked to risky behavior such that those who exhibit low self-regulation are more likely to engage in risky behaviors (Byrnes, 2005). Self-regulation can be broken down into two components; emotion regulation and cognitive regulation. In a study by Magar, Phillips, and Hosie (2008), participants were administered assessments of emotion regulation, cognitive regulation, risk perception, self-report smoking and alcohol use, and cost-benefit analysis tasks. The results of this study showed that cognitive regulation was predictive of rational decision making (i.e., cost-benefit analysis) and emotion regulation was predictive of actual risky behaviors (e.g., cigarette smoking and alcohol use). Specifically, low emotion self-regulators engaged in more risky behaviors and low cognitive self-regulators perceived the benefits associated with risk to be greater than high self-regulators.

Personality

Numerous studies have evaluated personality predictors of risk taking. In one such study,

Zuckerman and Kuhlman (2000) found that, in college students, risk taking (limited to smoking, drinking, drugs, sex, driving, and gambling) correlated with scores on measures of impulsive sensation seeking, aggression, and sociability. They also found that gender differences in risk taking were mediated by scores on impulsive sensation seeking. The scale used in this study to assess personality was the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ), a well validated and highly reliable measure of personality which measures five basic personality traits: impulsive sensation seeking, neuroticism-anxiety, aggression-hostility, activity, and sociability (Zuckerman & Kuhlman, 1998).

Demographics

Factors that are predictive of risky behaviors (particularly health risk behaviors) include being young, male, single, having a lower level of education, and white (see Verrall, 2009). These factors are irrelevant to whether one is in the military or is a civilian thus it is unclear if the military culture differs from that of the civilian population with regard to risk taking and ultimately drives further research in this area (Fear et al., 2007). With regard to this, preliminary analyses of a study of the British Army conducted by Neil Verrall (personal communication, July 23, 2008) indicated that there are no differences between the military and civilian populations in terms of sensation seeking.

Research objective

The objective of this study was two-fold: 1) to evaluate risk propensity and risk behavior in Soldiers as a function of deployment using a repeated measures, longitudinal design (i.e., the same group of Soldiers was tested pre- and post-deployment), 2) to evaluate the impact of PTSD and TBI on attitudes about risk and engagement in risky behaviors. The implications of the study results with respect to promotion of health and prevention of injury are discussed.

Method

Participants

Volunteers were recruited from a combat battalion (approximately 800 Soldiers) of a U.S. Army Infantry Division. Approximately 30 days prior to a 12-month deployment to Iraq (October 2009 to September 2010), 492 Soldiers completed the task battery (62% response rate); 387 of them returned to complete the task battery again, approximately one month post-deployment (79% retention rate). Permanent change of station, leave status, medical evacuation, or behavioral problems prior to the testing window precluded some Soldiers' post-deployment testing thus information about these individuals was unavailable. We were able to confidently match 319 pre-deployment and post-deployment datasets. Specifically, to preserve anonymity while matching a participant's dataset (pre-deployment and post-deployment data), an unidentifiable code was used to link the data. This code was generated using information provided by the participant. Thus, errors in entry yielded some unique codes that could not be matched (68 total unmatched). This study was reviewed and approved by the U.S. Army Medical

Research and Materiel Command Institutional Review Board (USAMRMC IRB) and conducted in compliance with federal regulations regarding protection of human subjects in research. Since participants were allowed to skip questions they did not feel comfortable answering, the number of participants available for analysis varied by measure. Specifically, if a participant skipped a question on a measure, the score on the validated measure could not be computed accurately, thus the participant was excluded from that measure. To be included in the analysis, participants had to complete 75% of the measures. Therefore, of the 319 matched datasets, 262 datasets were eligible for analysis.

To assess the representativeness of our sample, the demographic data were compared by means of the Defense Medical Surveillance System to those of active-duty Army personnel deployed to OIF and OEF (Ruberton & Brundage, 2002).

Surveys and outcome variables

Participants were categorized into one of four groups based on responses and scores from the 17-item PTSD Checklist-Military version (Bliese et al., 2008; Kang et al., 2003) and the Brief TBI Screen (Schwab et al., 2007) both of which were administered post-deployment. The *PTSD* group consisted of participants who screened positive as determined by guidelines published by the National Center for PTSD. The *TBI* group consisted of participants who screened positive for a probable TBI. The *PTSD w/TBI* group consisted of those who screened positive for both, and the *control* group was comprised of those who screened negative for both.

The pre-deployment test battery consisted of both neuropsychological assessments and questionnaires which were presented in random order. The questionnaires included a measure of personality – the Zuckerman-Kuhlman Personality Questionnaire (five factors: sociability, neuroticism, activity, impulsive sensation seeking, aggression; Zuckerman et al., 1993); a measure of emotion regulation – the Emotion Regulation Questionnaire (two factors: cognitive reappraisal and emotional suppression; Gross & John, 2003); baseline measures of depression and anxiety levels – Beck's Depression Inventory (Beck & Steer, 1984; Beck et al., 1988) and Beck's Anxiety Inventory (Beck et al., 1988; Hewitt & Norton, 1993); an inventory of health risk behaviors including questions from the alcohol use disorders identification test (Saunders et al., 1993), the Centers for Disease Control and Prevention's youth risk behavior survey regarding tobacco use (Center for Disease Control and Prevention, 2009), and the Driving Behavior Questionnaire (Parker, Reason, Manstead, & Stradling, 1995) as well as a question regarding Army Substance Abuse Program (ASAP) referral; a measure of risk propensity – the Evaluation of Risks Questionnaire (EVAR-English Version; three factors: need-for-control, self-confidence, risk/thrill seeking; Sicard et al., 2001; Killgore et al., 2006); and a measure of perceived invincibility, the Invincibility Belief Index (IBI; total invincibility belief score and three factors: adroitness, impunity, boldness; Killgore et al., 2010). Additionally, participants completed a measure of behavioral risk-taking – the Balloon Analogue Risk Task (Lejuez et al., 2002); and a behavioral decision making task incorporating uncertainty, reward, and punishment –the Iowa Gambling Task (Bechara et al., 1997; Bechara et al., 2001; Bechara et al., 2000). Measures of personality and self-regulatory competence were included given the relationship between these

individual differences and risky behavior (respectively, Zuckerman & Kuhlman, 2000; Byrnes, 2005).

The post-deployment test battery included the same instruments and tasks as the pre-deployment test battery with the addition of the 7-item combat exposure scale (Keane et al., 1989) and the deployment concerns sub-scale of the deployment risk and resilience inventory (King et al., 2003; King et al., 2006). These items characterized the participants' actual experiences and perceptions of the environment and threats while deployed.

Quality control and statistical design

All responses were recorded electronically using the psychological experiment software E-prime (version 2.0) and exported into Microsoft Office 2007 Excel for organization. Any questions that were skipped were identified in the dataset. As the responses were recorded electronically, the data file included the participants' reaction time to give a response which was recorded from the onset of the presentation of a question. Any reaction times that were less than a reasonable amount of time (which varied by instrument) to have read the question or observe the screen (whether by error or intentional) were marked as skipped questions in the dataset. All data were then imported to SPSS software (version 17.0) and analyzed using mixed model 4 (group: *PTSD, TBI, PTSD w/TBI, control*) X 2 (combat deployment: *pre-, post-*) analyses of variance (ANOVAs) and post-hoc tests. Given the unequal sample sizes between groups, Levene's test of homogeneity of variance was conducted. Additionally, a between-subjects ANOVA was conducted to compare the four groups' responses on the deployment concerns and combat experiences surveys. Finally, a multiple linear regression was conducted to evaluate potential predictors of probable PTSD (e.g., pre-deployment psychological disturbance).

Results

The sample was primarily composed of U.S. Army Soldiers with an infantry military occupational specialty (MOS). The top three most frequently reported MOSs were Infantry (32.6%), Armor Crewman (17.6%), and Combat Medic (5.6%). Although the demographic characteristics of our sample were largely similar to the reference group obtained from the Defense Medical Surveillance System, the rank distributions and age were slightly lower in our sample due to an undersampling of officers (table 1). Females were also underrepresented in our sample which is to be expected given that we sampled from an infantry battalion.

Table 1

Demographic characteristics of study groups of soldiers compared across conditions; frequency (percent).

Characteristic	Reference Group (*N* = 113,582)	Army Study Sample (*N* = 262)
Age		
18-24 yr	45,427 (40)	139 (53.6)
25-29 yr	29,172 (25.7)	70 (27.0)
30-39 yr	29,245 (25.7)	38 (14.7)
40 yr or older	9,738 (8.6)	12 (4.6)
Missing values		3
Sex		
Male	101,786 (89.6)	258 (99.2)
Female	11,796 (10.4)	2 (0.7)
Missing values		2
Race or Ethnic Group		
Caucasian	82,193 (72.4)	187 (71.4)
African American	20,819 (18.3)	31 (11.8)
Hispanic	12,617 (11.1)	32 (12.2)
Other	6,006 (4.2)	12 (4.6)
Education		
No high-school diploma	935 (0.7)	22 (8.4)
HS diploma or some college	101,114 (71.2)	220 (83.9)
College graduate	16,136 (11.4)	20 (7.6)
Military Grade		
Enlisted Personnel		
E1-E4	70,291 (49.5)	166 (63.4)
E5-E6	37,648 (26.5)	77 (29.3)
E7-E9	12,292 (8.7)	12 (4.6)
Officer	21,805 (15.4)	7 (2.6)
Prior Combat Experience		
Yes	Not available	127 (48.5)
No	Not available	135 (51.5)

Note. Military grades of E1 to E4 represent lower enlisted, E5 to E6 represent junior non-commissioned officers (NCOs), and E7 to E9 represent senior NCOs. Missing values are not represented, as some participants chose not to answer all questions. Percentages may not sum to 100 due to rounding. Reference group includes active-duty only Army personnel deployed to OIF in 2010.

A one-way ANOVA indicated significant differences between groups for the combat experiences survey scores such that the *control* group scored lower than the other three groups, $F(3, 242) = 7.031$, $p < .001$ (figure 1). Similarly, a one-way ANOVA showed that *PTSD* and *PTSD w/TBI* groups scored higher on the deployment concerns survey than the *control* and *TBI* groups, $F(3, 243) = 14.998$, $p < .001$ (figure 2). To characterize the deployment experiences for all participants, tables 2 and 3 summarize responses on both of these surveys.

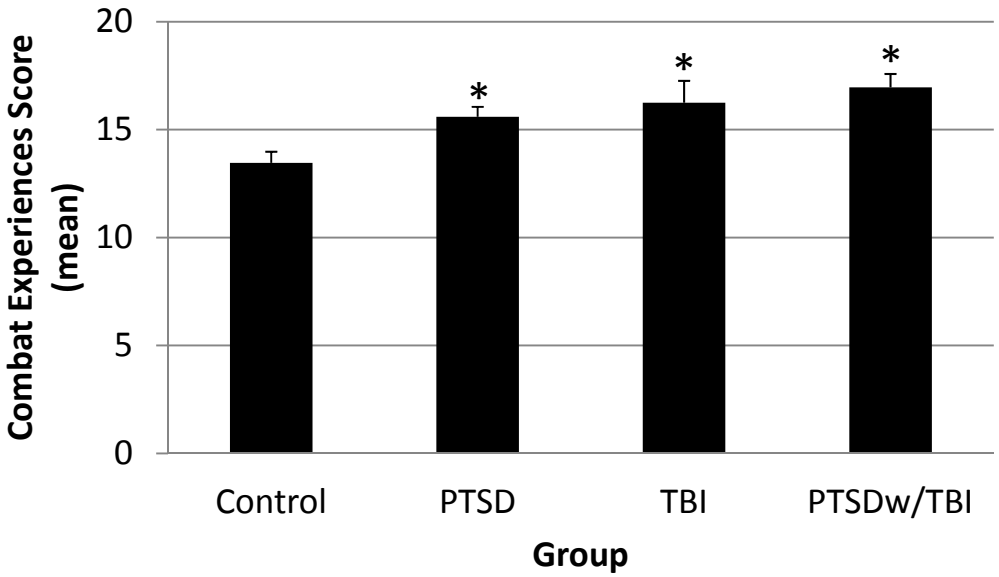

Figure 1. Bar graph of mean combat experiences score by group. Error bars represent standard error of the mean. * indicates a significant difference from *control* group at $p < 0.05$.

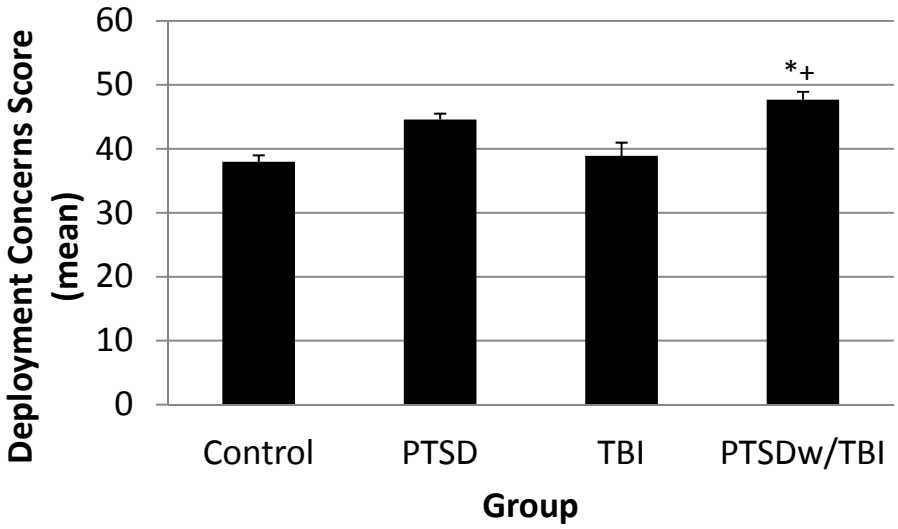

Figure 2. Bar graph of mean deployment concerns score by group. Error bars represent standard error of the mean. * indicates a significant difference from control group at $p < 0.05$. + indicates a significant difference from *TBI* group at $p < 0.05$.

Table 2.

Combat experience survey responses; frequency (percent)

	never	**1-2x**	**3-12x**	**13-50x**	**51+**
Did you ever go on combat patrols or have other dangerous duty?	17 (5.3)	13 (4.1)	25 (7.8)	37 (11.6)	209 (65.5)
How often did you fire rounds at the enemy?	172 (53.9)	61 (19.1)	36 (11.3)	9 (2.8)	12 (3.8)
How often did you see someone hit by incoming or outgoing rounds?	184 (57.7)	85 (26.6)	14 (4.4)	5 (1.6)	3 (0.9)
How often were you in danger of being injured or killed (i.e., being pinned down, overrun, ambushed, near miss, etc.)?	112 (35.1)	90 (28.2)	31 (9.7)	16 (5.0)	40 (12.5)
Were you ever surrounded by the enemy?	236 (83.4)	22 (6.9)	16 (5.0)	2 (0.6)	13 (4.1)
	never	**<1 month**	**1-3 months**	**4-6 months**	**7+ months**
Were you ever under enemy fire?	113 (35.4)	62 (19.4)	40 (12.5)	35 (11.0)	38 (11.9)
	never	**1-25%**	**26-50%**	**76%+**	
What percentage of the Soldiers in your unit were killed (KIA), wounded, or missing in action (MIA)?	51 (16.0)	234 (73.4)	2 (0.6)	1 (0.3)	

Table 3.
Deployment concerns survey responses; frequency (percent).

	Strongly Disagree	Somewhat Disagree	Neutral	Somewhat agree	Strongly Agree
I feel safe.	47 (14.7)	73 (22.9)	76 (23.8)	66 (20.7)	38 (11.9)
I felt secure that I would be coming home after the war.	16 (5.0)	25 (7.8)	79 (24.8)	75 (23.5)	103 (32.3)
I felt that I was in great danger of being killed or wounded.	43 (13.5)	44 (13.8)	90 (28.2)	82 (25.7)	38 (11.9)
I felt that I would become sick from the pesticides or other routinely used chemicals.	89 (27.9)	40 (12.5)	92 (28.8)	46 (14.4)	23 (7.2)
I thought I would never survive.	146 (45.8)	49 (15.4)	73 (22.9)	19 (6.0)	10 (3.1)
I thought that exposure to depleted uranium would negatively affect my health.	80 (25.1)	29 (9.1)	97 (30.4)	43 (13.5)	37 (11.6)
I thought that vaccinations I received would actually cause me to be sick.	83 (26.0)	37 (11.6)	73 (22.9)	54 (16.9)	48 (15.0)
I was afraid I would encounter a mine or booby trap.	75 (25.3)	57 (17.9)	73 (22.9)	61 (19.1)	30 (9.4)
I was afraid that the equipment I was given to protect me from IEDs would not work.	52 (16.3)	51 (16.0)	83 (26.0)	83 (26.0)	25 (7.8)
I was concerned about the health effects of breathing bad air.	55 (17.2)	29 (9.1)	88 (27.6)	71 (22.3)	52 (16.3)
I was concerned that my unit would be attacked by the enemy.	32 (10.0)	20 (6.3)	62 (19.4)	100 (31.3)	82 (25.7)
I was concerned that the tablets I took to protect me would make me sick.	92 (28.8)	36 (11.3)	97 (30.4)	29 (9.1)	28 (8.8)
I was extremely concerned that the enemy would use IEDs against me.	44 (13.8)	26 (8.2)	51 (16.0)	63 (19.7)	116 (36.4)
I worried about getting an infectious disease.	91 (28.5)	51 (16.0)	87 (27.3)	54 (16.9)	13 (4.1)
I worried about the possibility of accidents (e.g., friendly fire or training injuries in my unit).	80 (25.1)	70 (21.9)	80 (25.1)	47 (14.7)	19 (6.0)

Post-deployment scores of aggression, activity, neuroticism, perceived invincibility, adroitness, risk/thrill seeking, self-confidence, depression symptoms, frequency of drinking episodes, and referrals to the ASAP increased across all participants. Participants' scores of sociability and need for control decreased post-deployment. Smokers reported smoking less post-deployment and of those who reported riding a motorcycle, helmet-use decreased post-deployment (table 4). There were no significant main effects or interactions for the following measures: Zuckerman-Kuhlman Personality Questionnaire (impulsive sensation seeking subscale), Emotion Regulation Questionnaire, Invincibility Belief Index (impunity and boldness subscales), Balloon Analogue Risk Task, and Iowa Gambling Task.

Table 4.

Summary of results of 4 (control, PTSD, TBI, PTSD w/TBI) X 2 (pre-, post-deployment) ANOVAs.

Construct	***F***	**df**	***p***	***Partial η²***	**Comparison**	***p***
Main effect of combat deployment (pre, post)						
Sociability	6.938	1, 229	0.009	0.029	pre > post	0.009
Aggression	9.242	1, 233	0.003	0.038	pre < post	0.003
Activity	39.877	1, 235	< 0.001	0.145	pre < post	< 0.001
Neuroticism	13.052	1, 230	< 0.001	0.054	pre < post	< 0.001
IBI: Invincibility	48.14	1, 226	< 0.001	0.176	pre < post	< 0.001
IBI: Adroitness	106.996	1, 237	< 0.001	0.311	pre < post	< 0.001
EVAR: Risk/thrill seeking	22.504	1, 258	< 0.001	0.080	pre < post	< 0.001
EVAR: Self-confidence	157.48	1, 258	< 0.001	0.379	pre < post	< 0.001
EVAR: Need for control	14.488	1, 258	< 0.001	0.053	pre > post	< 0.001
Depression	4.682	1, 173	0.032	0.026	pre < post	0.032
Frequency of smoking	4.758	1, 169	0.031	0.027	pre > post	0.031
Frequency of drinking	3.946	1, 250	0.048	0.016	pre < post	0.048
Referred to ASAP	4.042	1, 250	0.045	0.016	pre < post	0.045
Motorcycle helmet use	5.164	1, 65	0.026	0.026	pre > post	0.026
Main effect of group (*PTSD, TBI, PTSD w/TBI, Control*)						
Sociability	5.932	3, 229	0.001	0.072	*control > PTSD*	0.002
					control > PTSD w/TBI	0.001
					TBI > PTSD	0.034
					TBI > PTSD w/TBI	0.009
Aggression	6.973	3, 233	< 0.001	0.082	*control < PTSD*	0.001
					control < PTSD w/TBI	< 0.001
					TBI < PTSD w/TBI	0.035
Neuroticism	16.594	3, 230	< 0.001	0.178	*control < PTSD*	< 0.001
					control < PTSD w/TBI	< 0.001
					TBI < PTSD w/TBI	0.001
					PTSD < PTSD w/TBI	0.019
Risk/thrill seeking	3.332	3, 258	0.02	0.037	*control < PTSD*	0.007
					control < PTSD w/TBI	0.008
Anxiety	26.735	3, 245	< 0.001	0.247	*control < PTSD*	< 0.001
					control < TBI	0.012
					control < PTSD w/TBI	< 0.001
					PTSD < PTSD w/TBI	< 0.001

Table 4 (continued)

					TBI < *PTSD w/TBI*	< 0.001
Depression	19.038	3, 173	< 0.001	0.248	*control* < *PTSD*	< 0.001
					control < *PTSD w/TBI*	< 0.001
					PTSD < *PTSD w/TBI*	0.002
					TBI < *PTSD w/TBI*	< 0.001
Cigarettes per day	3.029	3, 170	0.031	0.051	*control* < *PTSD*	0.003
Alcoholic drinks per day	3.392	3, 247	0.019	0.096	*control* < *PTSD*	0.008
					control < *PTSD w/TBI*	0.006
Frequency of speeding	8.957	3, 253	< 0.001	0.092	*control* < *PTSD*	< 0.001
					control < *PTSD w/TBI*	< 0.001
					TBI < *PTSD*	0.04
					TBI < *PTSD w/TBI*	0.007
Frequency of drinking	5.03	3, 250	0.002	0.057	*control* < *PTSD*	0.001
					control < *PTSD w/TBI*	0.001
Felt need to cut down drinking	3.468	3, 235	0.017	0.042	*control* < *PTSD*	0.045
					control < *PTSD w/TBI*	0.002
Drunk driving	2.667	3, 245	0.048	0.032	*control* < *PTSD w/TBI*	0.01
Used more alcohol than intended	5.816	3, 244	0.001	0.067	*control* < *PTSD*	< 0.001
					control < *PTSD w/TBI*	< 0.001
Interaction						
Anxiety	8.563	3, 245	< 0.001	0.095	see Figure 3	
Depression	3.421	3, 173	0.019	0.560	see Figure 3	
Self-confidence	2.655	3, 258	0.049	0.030	see Figure 3	

Overall, the results showed that the *PTSD* and *PTSD w/TBI* groups scored higher on aggression, neuroticism, risk/thrill seeking; and reported more drinks consumed during a drinking episode, more frequent drinking episodes, feeling the need to cut down on drinking, and using more alcohol than intended than the *control* group. Similarly, the *PTSD w/TBI* groups scored higher on aggression than the *TBI* group, higher on neuroticism than the *PTSD* and *TBI* groups, and reported more drunk-driving episodes than the *control* group. The pattern of depression and anxiety was such that the *PTSD w/TBI* group scored the highest followed by the *PTSD* group, *TBI* group, and *control* group in decreasing order. Both the *control* and *TBI* groups scored higher on sociability than the *PTSD* and *PTSD w/TBI* groups. The *PTSD* and *PTSD w/TBI* groups reported more frequent episodes of speeding (both highway and residential) than the

control and *TBI* groups. Finally, of those who reported smoking, the *PTSD* group reported smoking more cigarettes per day than the *control* group.

All groups showed an increase in self-confidence (i.e., enhanced sense of assuredness and preference for danger), however, the quantity of this increase was greater in the *PTSD* and *PTSD w/TBI* groups than the others. The *control* and *TBI* groups showed a decrease in anxiety levels post-deployment whereas the *PTSD* and *PTSD w/TBI* groups showed an increase. Post-deployment depression symptoms decreased for the *control* group while increasing for all other groups (figure 3).

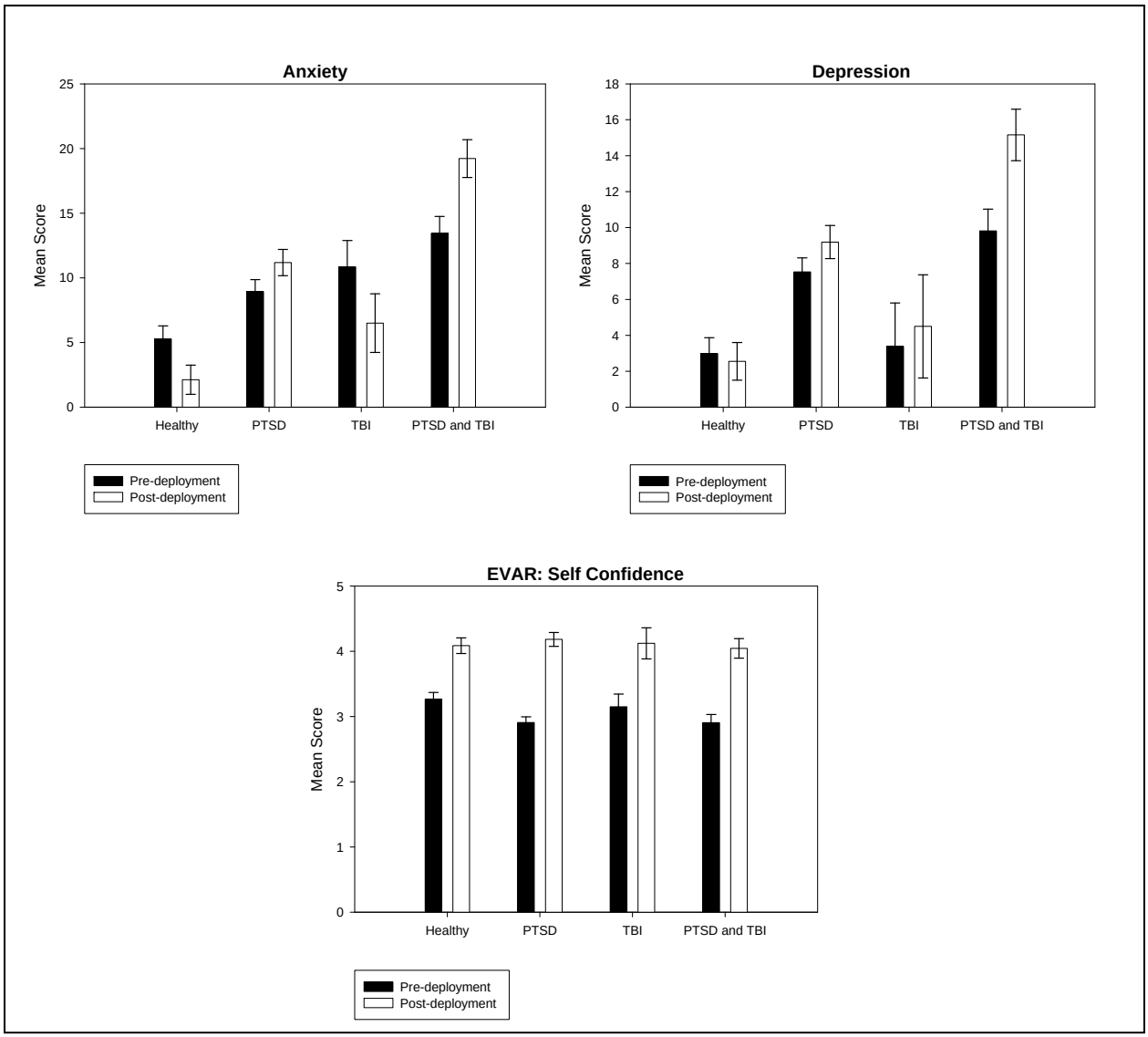

Figure 3. Bar graphs of interaction effects of combat deployment and group on anxiety, depression, and self-confidence.

To evaluate the extent to which pre-deployment psychological disturbance (anxiety and depression), combat experiences during deployment, concerns and threat during deployment, and previous combat deployment impacted PTSD score post-deployment, a multiple linear regression was conducted. The model showed that measures of depression pre-deployment and perceived threat during deployment significantly predicted PTSD score and accounted for 32.6% of the variance, $R^2 = 0.326$, $F(5, 180) = 17.383$, $p < 0.001$. Specifically, Beck's depression inventory score pre-deployment, $\beta = 0.257$, $t(185) = 3.655$, $p < 0.001$, and deployment concerns score (post-deployment), $\beta = 0.341$, $t(89) = 5.267$, $p < 0.001$, were significant predictors of PTSD scores. Pre-deployment anxiety, combat experience, and previous deployment were not significant predictors.

Discussion

The results of this study strongly suggest that changes in attitudes about risk, risk propensity, and health risk behaviors occur after a combat deployment. Specifically, participants reported increased frequency of alcohol consumption and referrals to ASAP after returning home. Participants who were motorcycle riders reported decreased frequency of helmet use post-deployment. The magnitude of these changes was amplified in participants who screened positive for PTSD. While the statistical significance of the effects of combat deployment, PTSD, and TBI is important, these findings are strengthened by the medium to large effect sizes found as well. The implications of these findings touch a broad range of concerns including public health, return-to-duty and operational readiness, personal safety, and readjustment to life after a deployment.

Participants' responses indicate a greater sense of invincibility and adroitness, as well as self-confidence, post-deployment compared to pre-deployment. This altered self-perception is understandable, as these Soldiers had recently survived a uniquely dangerous period of life, thus amplifying the perception of their survival abilities and diminishing their perceived susceptibility to negative consequences. These alterations may function as a coping mechanism such that emotional stability is fostered by moving forward from the experience rather than dwelling on the idea that one might not have survived (Bell et al., 2001). Survival is unconsciously attributed to one's exceptional survival skills or invincibility. While this may promote emotional stability and health, the consequence of this altered perception is that a Soldier may engage in dangerous behaviors. Also, there is no indication as to if and when these coping behaviors become a negative habit versus a helpful strategy. The extent to which this altered perception and behaviors serve as an effective coping mechanism is unknown.

Interestingly, participants' personality traits related to risk-taking changed across the deployment cycle. Personality was traditionally thought to be relatively stable once adulthood is reached. A recent review shows that personality continues to adapt and develop across adulthood typically in the positive direction (McCrae & Costa, 1994; Roberts & Mroczek, 2008). The results of the current study suggest that aspects of personality may seem altered by the life experience of a combat deployment independent of psychological injury. This finding can be summed up as the commonly reported anecdote "you are just not the same" after a deployment.

However, the permanence of this "alteration" was not assessed thus making it impossible to interpret whether this change is simply a short-term adaptation effect or if it is long-term.

In our study, Soldiers exhibiting PTSD symptoms were susceptible to changes in attitude, perception, and behavior. Those who screened positive for PTSD reported more frequent reckless driving in both residential and built-up areas as well as highway driving. The *PTSD* and *PTSD w/TBI* groups also reported more frequent alcohol consumption and quantity consumed during a drinking episode. Of the participants who reported smoking, those with PTSD symptoms smoked more heavily than the healthy participants overall. Drunk driving and feelings of need to cut down on alcohol consumption were also reported as occurring more frequently post-deployment in the *PTSD* and *PTSD w/TBI* groups. While health risk behaviors increased post-deployment regardless of TBI or PTSD, the range of behaviors and frequency of behaviors reported overall were exaggerated in those screened positive for PTSD.

Personality dimensions related to sociability, aggression, and neuroticism differed between groups such that *PTSD* and *PTSD w/TBI* groups were less sociable, more aggressive, and more neurotic than the *control* and *TBI* groups. These differences did not interact with phase of testing (pre- versus post-deployment) suggesting that personality may play a role in resilience to PTSD. Anxiety and depression decreased post-deployment for healthy participants whereas these variables increased for those who screened positive for PTSD. For all Soldiers, pre-deployment is a stressful time where tight training schedules demand one's time as well as preparation for the family left behind (e.g., finances, wills, childcare, thoughts of injury or death). For those who return relatively healthy, post-deployment is a time of relief (e.g., reconnecting with family and friends, familiarity and predictability, feelings of safety and security) which is not the case for those experiencing psychological problems.

Practical implications

Engaging in risky behaviors such as alcohol use and smoking puts not only individual health and safety but also family safety and public health in jeopardy. The findings of this study expand beyond health risk behaviors and suggest that perception of risks and attitudes about invincibility are altered after a combat deployment. This skewed perception of risk endangers more aspects of a Soldier's life than off-duty health and safety. The results also suggest that this change is not limited to those with symptoms of psychological injury thus providing an additional challenge to leaders to identify and initiate measures to help those at risk while maintaining stewardship of other competing issues.

Operational readiness

Operational readiness is another potential area of a Soldier's life that is open for hazardous consequences. At present, it is unclear if and when these alterations to risk perception actually begin to take effect. If a Soldier engages in riskier behavior while still in a combat environment, consequences could be fatal. To a lesser extreme, once redeployed and returned-to-duty, military operations may be compromised due to a Soldier's disproportionate view of risk.

Unit readiness

Awareness of the common risk taking behaviors, implementation of available resources, and visibility by key leaders embodies a synergistic approach to safeguarding unit readiness. Currently medical providers can identify a Soldier in need through the post-deployment health re-assessment (PDHRA) within a 30-, 60-, and 90-day visit. Medical providers, in turn, can communicate insight to their leadership who will empower supervisors to initiate available resources within the organization and installation. Through active participation and continued support, a service member can increase his/her personal resilience to adapt and potentially overcome his/her limitations. In essence, identification and prevention of risk taking behaviors allows leadership to negotiate Soldier issues with greater fluidity and improved outcomes.

Risk reduction

The Headquarters, Department of the Army (2010) Health Promotion, Risk Reduction, and Suicide Prevention Report emphasizes the need for key leaders at all levels to re-learn the "lost art of garrison leadership." Building unit, individual, and Army family resiliency is an important component in high risk behavior reduction. Understanding and then tapping into myriad programs that already exist to build resiliency will help leaders reduce risky behaviors. These programs/initiatives and their respective proponents include the ASAP (Installation Management Command; IMCOM), the Comprehensive Behavior Health System of Care- Campaign Plan (Medical Command; MEDCOM), and the Strong Bonds Couples Program (Chaplain's Corps). Leveraging IMCOM's Risk Reduction Program and MEDCOM's pre- and post-deployment, and re-deployment assessments (Physical Disability Agency, Post-deployment Health Reassessment) will help identify Soldiers and units at risk for unhealthy behaviors. Again, building resiliency at all levels will ensure that Soldiers remain "Army Strong."

Study limitations and future research

While the results of this study provide a characterization of the pattern of health risk behaviors and attitudes about risk across the combat deployment cycle as well as illuminating differences in behaviors and attitudes between those who screened positive for PTSD and/or TBI and those who did not, there are limitations that should be considered when interpreting these data. First, given the nature of a quasi-experimental study, PTSD and TBI were not randomly assigned and thus resulted in unequal sample sizes. Since unequal sample size lends to a violation of the assumption of homogeneity, a statistical test of the assumption supported the robustness of the findings. Secondly, the only injury information collected was related to PTSD and TBI whereas the experience of sustaining other injuries during deployment may have also influenced participants' responses. Third, the groups were categorized based on a self-report screening tool which is far less sophisticated than the standard methods applied for diagnosing PTSD and TBI. The significant results obtained despite this crude method of assessment, however, lend strength to the findings. Fourth, some participants were unavailable for testing post-deployment due to behavioral problems or medical evacuation prior to the testing window; these untested subgroups could exhibit different patterns of post-deployment risk-taking

behavior. Also, participants were allowed to skip questions they did not feel comfortable answering. These factors lend to concerns of differential attrition. Finally, the sample studied was not a random sample of Soldiers but rather a convenience sample which poses a threat to the external validity of these results. To address this limitation, the representativeness of the sample was presented.

Whereas this study contributes to the understanding of changes in risk attitudes by documenting the pattern of engagement in risky behavior across the combat deployment cycle, much work is yet to be done. Specifically, the time course of these changes is unknown. A longitudinal assessment extending at a least a year after redeployment would shed light on the longevity of this problem. Likewise, a more controlled and sophisticated investigation into the impact of PTSD, with and without a history of TBI, on risk attitudes and health risk behaviors is needed to develop causal inferences about the relationship between PTSD and risk-taking. Studies are currently underway to model the predictive value of individual differences (e.g., personality, emotion regulation, combat experiences, deployment concerns) on risk attitudes and risk behaviors.

Conclusions

The results of this longitudinal study support previous anecdotal and between-subjects evidence suggesting that Soldiers are more likely to engage in risky behaviors post-deployment compared to pre-deployment. Changes were evident in all groups of Soldiers, but were most pronounced in who screened positive for PTSD (with or without TBI).

References

Bechara, A., Damasio, H., Tranel, D., and Damasio, A. R. 1997. Deciding advantageously before knowing the advantageous strategy. Science. 75: 1293-1295.

Bechara, A., Dolan, S., Denburg, N., Hindes, A., Anderson, S. W., and Nathan, P. E. 2001. Decision-making deficits, linked to a dysfunctional ventromedial prefrontal cortex, revealed in alcohol and stimulant abusers. Neuropsychologia. 39: 376-89.

Bechara, A., Tranel, D., and Damasio, H. 2000. Characterization of the decision-making deficit of patients with ventromedial prefrontal cortex lesions. Brain. 123: 2189-2202.

Beck, A. T., Epstein, N., Brown, G., and Steer, R. A. 1988. An inventory for measuring clinical anxiety: Psychometric properties. Journal of Consulting and Clinical Psychology. 56: 893-897.

Beck, A. T., and Steer, R. A. 1984. Internal consistencies of the original and revised Beck Depression Inventory. Journal of Clinical Psychology. 40: 1365-1367.

Beck, A. T., Steer, R. A., and Garbin, G. M. 1988. Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. Clinical Psychology Review. 8: 77-100.

Bell, N. S., Amoroso, P. J., Wegman, D. H., and Senier, L. 2001. Proposed explanations for excess injury among veterans of the Persian Gulf War and a call for greater attention from policymakers and researchers. Injury Prevention. 7: 4-9.

Bliese, P. D., Wright, K. M., Adler, A. B., Cabrera, O., Castro, C. A., and Hoge, C. W. 2008. Validating the PC-PTSD and the PTSD Checklist with Soldiers returning from combat. Journal of Consulting and Clinical Psychology. 76: 272-281.

Byrnes, J. P. 2005. The development of self-regulated decision making. In J. E. Jacobs, and P. A. Klaczynski (Eds.). The development of judgment and decision making in children and adolescents. 5-38. Mahwah, NJ: Lawrence Erlbaum Associates.

Centers for Disease Control and Prevention. 2009. Youth Behavior Risk Survey. (Accessed July 23, 2009, at http://www.cdc.gov/yrbss.).

Fear, N. T., Iversen, A., Meltzer, H., Workman, L., Hull, L., Greenberg, N., et al. 2007. Patterns of drinking in the UK Armed Forces. Addiction. 102: 1749-1759.

Gross, J. J., and John, O. P. 2003. Individual differences in two emotion regulation processes: Implications for affect, relationships, and well-being. Journal of Personality and Social Psychology. 85: 348-362.

Hewitt, P. L., and Norton, G. R. 1993. The Beck Anxiety Inventory: A psychometric analysis. Psychological Assessment. 5: 408-412.

Hoge, C. W., Castro, C. A., Messer, S. C., McGurk, D., Cotting, D. I., and Koffman, R. L. 2004. Combat duty in Iraq and Afghanistan, mental health problems, and barriers to care. New England Journal of Medicine. 351: 13-22.

Kang, H. K., Natelson, B. H., Mahan, C. M., Lee, K. Y., and Murphy, F. M. 2003. Post-traumatic stress disorder and chronic fatigue syndrome-like illness among Gulf War veterans: A population-based survey of 30,000 veterans. American Journal of Epidemiology. 157: 141-148.

Keane, T., Fairbank, J., Caddell, J., Zimering, R., Taylor, K., and Mora, C. 1989. Clinical evaluation of a measure to assess combat exposure. Psychological Assessment. 1: 53-55.

Killgore, W. D. S., Cotting, D. I., Thomas, J. L., Cox, A. L., McGurk, D., Vo, A. H., et al. 2008. Post-combat invincibility: Violent combat experiences are associated with increased risk-taking propensity following deployment. Journal of Psychiatric Research. 42: 1112-1121.

Killgore, W. D. S., Kelley, A. M., and Balkin, T. 2010. So you think you're bulletproof: Development and validation of the Invincibility Belief Index (IBI). Military Medicine. 175: 499-508.

Killgore, W. D. S., Vo, A. H., Castro, C. A., and Hoge, C. W. 2006. Assessing risk propensity in American soldiers: preliminary reliability and validity of the Evaluation of Risks (EVAR) Scale – English version. Military Medicine. 171: 233-239.

King, D. W., King, L. A., and Vogt, D. S. 2003. Manual for the Deployment Risk and Resilience Inventory (DRRI): A collection of scales for studying deployment-related experiences in military veterans. Boston, MA: National Center for PTSD.

King, L. A., King, D. W., Vogt, D. S., Knight, J., and Samper, R. 2006. Deployment Risk and Reslience Inventory: A collection of measures for studying deployment-related experiences in military personnel and veterans. Military Psychology. 18: 89-120.

Lejuez, C. W., Read, J. P., Kahler, C. W., Richards, J. B., Ramsey, S. E., Stuart, G. L., et al. 2002. Evaluation of a behavioral measure of risk taking: The Balloon Analogue Risk Task (BART). Journal of Experimental Psychology: Applied. 8: 75-84.

Magar, E. C. E., Phillips, L. H., and Hosie, J. A. 2008. Self-regulation and risk-taking. Personality and Individual Differences. 45: 153-159.

McCrae, R. R., and Costa, P. T. 1994. The stability of personality: Observation and evaluations. Current Directions in Psychological Science. 3: 173-175.

Molina, M. E., Isoardi, R., Prado, M. N., and Beltolila, S. 2007. Basal cerebral glucose distribution in long-term post-traumatic stress disorder. World Journal of Biological Psychiatry. 13: 1-9.

O'Jile, J. R., Ryan, L. M., Parks-Levy, J., Betz, B., and Gouvier, W. D. 2004. Sensation seeking and risk behaviors in young adults with and without a history of head injury. Applied Neuropsychology. 11:107-112.

Parker, D., Reason, J. T., Manstead, A. S. R., and Stradling, S. 1995. Driving errors, driving violations and accident involvement. Ergonomics. 38:1036-1048.

Roberts, B. E., and Mroczek, D. K. 2008. Personality trait stability and change. Current Directions in Psychological Science. 17: 31-35.

Ruberton, M. V., and Brundage, J. F. 2002. The Defense Medical Surveillance System and the Department of Defense serum repository: Glimpses of the future of public health surveillance. American Journal of Public Health. 92: 1900-1904.

Saunders, J. B., Aasland, O. G., Babor, T. F., de la Fuente, J. R., and Grant, M. 1993. Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persona with harmful alcohol consumption. Addiction. 88: 791-803.

Schneiderman, A. I., Braver, E. R., and Kang, H. K. 2008. Understanding sequelae of injury mechanisms and mild traumatic brain injury incurred during the conflicts of Iraq and Afghanistant: Persistent postconcussive symptoms and posttraumatic stress disorder. American Journal of Epidemiology. 15: 1446-52.

Schwab, K. A., Ivins, B., Cramer, G., Johnson, W., Sluss-Tiller, M., Kiley, K., et al. 2007. Screening for traumatic brain injury in troops returning from deployment in Afghanistan and Iraq: Initial investigation of the usefulness of a short screening tool for traumatic brain injury. Journal of Head Trauma Rehabilitation. 22: 377-389.

Sharkansky, E. J., King, D. W., King, L. A., Wolfe, J., Erickson, D. J., and Stokes, L. R. 2000. Coping with Gulf War combat stress: mediating and moderating effects. Journal of Abnormal Psychology. 109: 188-197.

Sicard, B., Jouve, E., and Blin, O. 2001. Risk propensity assessment in military special operations. Military Medicine. 166: 871-874.

Tanielian T., and Jaycox L. H., eds. 2008. Invisible wounds of war: Psychological and cognitive injuries, their consequences, and services to assist recovery. Santa Monica, CA: RAND Corporation.

Thomsen, C. J., Stander, V. A., McWhorter, S. K., Rabenhorst, M. M., and Milner, J. S. 2011. Effects of combat deployment on risky and self-destructive behavior among active duty military personnel. Journal of Psychiatric Research. doi: 10.1016/j.jpsychires.2011.04.003.

HQS, Department of the Army. 2010. Health promotion, risk reduction, and suicide prevention report. (Accessed June 21, 2011, at http://www.army.mil/article/42934/army-health-promotion-risk-reduction-and-suicide-prevention-report/.)

Verrall, N. G. 2009. The role of risk in the health behaviours of military personnel in the UK Armed Forces. DSTL/TR32021. Porton Down, Wiltshire, UK: Defence Science and Technology Laboratory.

Zuckerman, M. 1994. Behavioral Expressions and Biosocial Bases of Sensation Seeking. Cambridge University Press: Cambridge.

Zuckerman, M., and Kuhlman, D. M. 1998. Norms for the Zuckerman-Kuhlman Personality Questionnaire. Unpublished manual.

Zuckerman, M., and Kuhlman, D. M. 2000. Personality and risk-taking: Common biosocial factors. Journal of Personality. 68: 999-1029.

Zuckerman, M., Kuhlman, D. M., Joireman, J., Teta, P., and Kraft, M. 1993. A comparison of three structural models for personality: The big three, the big five, and the alternative five. Journal of Personality and Social Psychology. 65: 757-768.

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